WHAT IS CLAIMED:

1. A process for producing III-V or II-VI nanocrystals comprising:

(a) reacting a compound of formula (I) with a compound of formula (II)

ML_n (I) $E(SiR_3)_n$ (II)

wherein:

n is 3, and M is a Group III metal, and E is a Group V element, or

n is 2, and M is a Group II, and E is a Group VI element;

L is a ligand; and

R is selected from the group consisting of H, $-(CH_2)_mCH_3$, $-(C(CH_2)_2)_mCH_3$, $-(C(CH_2)_2)_m(CH_2)_zCH_3$, $-(CH_2)_m(C(CH_2)_2)_zCH_3$, and any combination thereof, wherein m and z are real numbers,

under conditions effective to produce homogeneous nucleation of seed III-V or II-VI nuclei and a compound of formula (III)

$LSiR_3$ (III) ; and

(b) permitting reaction to occur between the seed III-V or II-VI nuclei and the compound of formula (III) under conditions effective to produce III-V or II-VI nanocrystals.

2. The process as claimed in claim 1, wherein M is selected from the group consisting of Al, Ga, and In, and E is selected from the group consisting of N, P, As, and Sb.

3. The process as claimed in claim 1, wherein M is selected from the group consisting of Cd, Zn, Mg, and Hg, and E is selected from the group consisting of O, S, Se, and Te.

4. The process as claimed in claim 1, wherein L is selected from the group consisting of $-E^1R^1_2$, $-E^2R^1$, $-E^2C(O)R^1$, and beta-diketonates or beta-diketonate derivatives, wherein:

E^1 is a Group V element;

E^2 is a Group VI element; and

R^1 is selected from the group consisting of -H, $-(CH_2)_mCH_3$, $-(C(CH_2)_2)_mCH_3$,

$-(C(CH_2)_2)_m(CH_2)_zCH_3$, $-(CH_2)_m(C(CH_2)_2)_zCH_3$, and any combination thereof, wherein m and z are real numbers.

5. The process as claimed in claim 1, wherein R is alkyl.

6. The process as claimed in claim 5, wherein R is methyl.

7. The process as claimed in claim 1, wherein the compound of formula (I) is present in solution with a non-coordinating solvent.

8. The process as claimed in claim 7, wherein the non-coordinating solvent is selected from the group consisting of benzene, toluene, xylene, decane, and octadecene.

9. A process for producing nanocrystals having multiple layers of III-V or II-VI material, comprising:

(a) reacting a compound of formula (I) with a compound of formula (II)

ML_n (I) $E(SiR_3)_n$ (II)

wherein:

n is 3, and M is a Group III metal, and E is a Group V element, or

n is 2, and M is a Group II, and E is a Group VI element;

L is a ligand; and

R is selected from the group consisting of H, $-(CH_2)_mCH_3$, $-(C(CH_2)_2)_mCH_3$, $-(C(CH_2)_2)_m(CH_2)_zCH_3$, $-(CH_2)_m(C(CH_2)_2)_zCH_3$, and any combination thereof, wherein m and z are real numbers,

under conditions effective to produce homogeneous nucleation of seed III-V or II-VI nuclei and a compound of formula (III)

$LSiR_3$ (III) ; and

(b) permitting reaction to occur between the seed III-V or II-VI nuclei and the compound of formula (III) under conditions effective to produce III-V or II-VI nanocrystals;

(c) reacting the product of step (b) with a source of a Group III metal and a Group V element, or with a source of a Group II metal and a Group VI element, under

conditions effective to produce nanocrystals having multiple layers of III-V or II-VI material.

10. The method according to claim 9, wherein the multiple layers of III-V or II-VI material comprise the same material.

11. The method according to claim 9, wherein the multiple layers of III-V or II-VI material comprise different materials.

12. The method as claimed in claim 9, further comprising after step (c), one or more sequential reacting steps comprising reacting the product of the previous step with a source of a Group III metal and a Group V element, or with a source of a Group II metal and a Group VI element, under conditions effective to produce nanocrystals having multiple layers of III-V or II-VI material.

13. The method according to claim 12, wherein the multiple layers of III-V or II-VI material comprise the same material.

14. The method according to claim 12, wherein the multiple layers of III-V or II-VI material comprise different materials.

15. The process as claimed in claim 9, wherein M is selected from the group consisting of Al, Ga, and In, and E is selected from the group consisting of N, P, As, and Sb.

16. The process as claimed in claim 9, wherein M is selected from the group consisting of Cd, Zn, Mg, and Hg, and E is selected from the group consisting of O, S, Se, and Te.

17. The process as claimed in claim 9, wherein L is selected from the group consisting of $-E^1R^1_2$, $-E^2R^1$, $-E^2C(O)R^1$, and beta-diketonates or beta-diketonate derivatives, wherein:

E^1 is a Group V element;

E^2 is a Group VI element; and

R^1 is selected from the group consisting of H, $-(CH_2)_mCH_3$, $-(C(CH_2)_2)_mCH_3$, $-(C(CH_2)_2)_m(CH_2)_zCH_3$, or $-(CH_2)_m(C(CH_2)_2)_zCH_3$, and any combination thereof, wherein m and z are real numbers.

18. The process as claimed in claim 9, wherein R is alkyl.

19. The process as claimed in claim 18, wherein R is methyl.

20. The process as claimed in claim 9, wherein the compound of formula (I) is present in solution with a non-coordinating solvent.

21. The process as claimed in claim 20, wherein the non-coordinating solvent is selected from the group consisting of benzene, toluene, xylene, decane, and octadecene.

22. The process as claimed in claim 9, wherein the source of a Group III metal or the source of a Group II metal is a compound of formula (IV):

$$MX_n \quad (IV)$$

wherein

X is selected from the group consisting of Cl, carboxylate, carbonate, $-E^1R^1_2$, $-E^2R^1$, $-E^2C(O)R^1$, and beta-diketonates or beta-diketonate derivatives, wherein:

E^1 is a Group V element;

E^2 is a Group VI element; and

R^1 is selected from the group consisting of H, $-(CH_2)_mCH_3$, $-(C(CH_2)_2)_mCH_3$, $-(C(CH_2)_2)_m(CH_2)_zCH_3$, $-(C(CH_2)_2)_m(C(CH_2)_zCH_3$, and any combination thereof, wherein m and z are real numbers.

23. A process for producing nanocrystals having multiple layers of III-V or II-VI material, comprising:

(a) providing a supply of seed III-V or II-VI nanocrystals; and

(b) reacting the seed III-V or II-VI nanocrystals with a source of a Group III metal and a Group V element, or with a source of a Group II metal and a Group VI element, under conditions effective to produce nanocrystals having multiple layers of III-V or II-VI material.

24. The method according to claim 23, wherein the multiple layers of III-V or II-VI material comprise the same material.

25. The method according to claim 23, wherein the multiple layers of III-V or II-VI material comprise different materials.

26. The method as claimed in claim 23, further comprising after step (b), one or more sequential reacting steps comprising reacting the product of the previous step with a source of a Group III metal and a Group V element, or with a source of a Group II metal and a Group VI element, under conditions effective to produce nanocrystals having multiple layers of III-V or II-VI material.

27. The method according to claim 26, wherein the multiple layers of III-V or II-VI material comprise the same material.

28. The method according to claim 26, wherein the multiple layers of III-V or II-VI material comprise different materials.

29. The process as claimed in claim 23, wherein the source of a Group III metal or the source of a Group II metal is a compound of formula (IV):

$$MX_n \quad (IV)$$

wherein

n is 3, and M is a Group III metal, or

n is 2, and M is a Group II, ;

X is selected from the group consisting of Cl, carboxylate, carbonate, $-E^1R^1_2$, $-E^2R^1$, $-E^2C(O)R^1$, and beta-diketonates or beta-diketonate derivatives, wherein:

E^1 is a Group V element;

E^2 is a Group VI element; and

R^1 is selected from the group consisting of H, $-(CH_2)_mCH_3$, $-(C(CH_2)_2)_mCH_3$, $-(C(CH_2)_2)_m(CH_2)_zCH_3$, $-(C(CH_2)_2)_m(C(CH_2)_zCH_3$, and any combination thereof, wherein m and z are real numbers.

30. A process for producing a compound of formula (VII) $M^1(ER^3_x)_3$, comprising:

(a) reacting a compound of formula (V) with a compound of formula (VI)

$M^1(C_5R^2_kH_{5-k})_3$ (V) HER^3_x (VI)

wherein:

M^1 is a Group III metal;

R^2 is selected from the group consisting of H, $-(CH_2)_mCH_3$, $-(C(CH_2)_2)_mCH_3$, $-(C(CH_2)_2)_m(CH_2)_zCH_3$, $-(CH_2)_m(C(CH_2)_2)_zCH_3$, and any combination thereof, wherein m and z are real numbers;

k is 0-5;

x is 2, and E is a Group V element or

x is 1, and E is a Group VI element; and

R^3 is selected from the group consisting of H, $-(CH_2)_mCH_3$, $-(C(CH_2)_2)_mCH_3$, $-(C(CH_2)_2)_m(CH_2)_zCH_3$, $-(CH_2)_m(C(CH_2)_2)_zCH_3$, and any combination thereof, wherein m and z are real numbers, and when x is 1, R^3 may additionally be $C(O)R^3$,

under conditions effective to produce a compound of formula (VII).

31. The process as claimed in claim 30, wherein M^1 is selected from the group consisting of Al, Ga, and In.

32. The process as claimed in claim 30, wherein x is 2, and E is selected from the group consisting of N, P, As, and Sb.

33. The process as claimed in claim 30, wherein x is 1, and E is selected from the group consisting of O, S, Se, and Te.

34. The process as claimed in claim 30, wherein the compound of formula (V) is selected from the group consisting of $In(C_5H_5)_3$, $In(C_5H_4Me)_3$, $In(C_5Me_5)_3$, and $In(C_5H_4(CH_2C(CH_3)_3)$.

35. The process as claimed in claim 30, wherein the compound of formula (VI) is selected from the group consisting of myristic acid, stearic acid, lauric acid, decanoic acid, 1-octadecanol, 1-octadecanethiol, dodecylamine, dioctadecylamine, dioctylphosphine, and diocyadecylarsine.

36. The process as claimed in claim 30, wherein the compound of formula (VII) is selected from the group consisting of $In(Myristate)_3$, $In(Laurate)_3$, $In(Stearate)_3$, $In(Decanoate)_3$, $In(octadecanoate)_3$, $In(octadecanethiolate)_3$, $In(N(C_{12}H_{25})_2)_3$, $In(N(C_{18}H_{37})_2)_3$, $In(P(C_{18}H_{37})_2)_3$, and $In(As(C_{18}H_{37})_2)_3$.